



FAA-C-2799
August 25, 1988

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DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION SPECIFICATION

Rehabilitation Of Standard ASR-4/5
Building To Accept ASR-7/8 With Mode S



TC/01

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Suggested Wording for FAA to
Incorporate into Division I on
Specification FAA-C-2799

DIVISION I - GENERAL REQUIREMENTS

1-1 SUMMARY OF WORK

1-1.1 General.- These specifications, together with the referenced specifications, standards and drawings specified in the Contract Documents, cover the requirements of the Federal Aviation Administration, hereinafter referred to as the Government or FAA, for all work associated with the rehabilitation of an existing airport surveillance radar (ASR) facility, mode ASR-4 or 5 to accept ASR-7 or 8 equipment with Mode S.

1-1.2 Scope.- The work includes rehabilitation of electrical and HVAC systems and the construction and installation of appurtenances to the foregoing as specified and indicated by the drawings or required by the FAA standard specifications which are a part of this contract. The work also includes installation of a government-furnished engine generator.

15-1/01

15-1 HEATING, VENTILATING AND AIR-CONDITIONING

15-1.1 General.-

15-1.1.1 Scope.- This section specifies heating, ventilating and air-conditioning. The system consists of single package air-cooled, vertical wall-mounted type, unitary air-conditioner including metal wall sleeve, automatic temperature control system, electric unit heaters, motorized automatic dampers, interconnecting wiring and modification of existing air-conditioning unit..

15-1.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

15-1.2.1 Air-Conditioning and Refrigeration Institute (ARI).-

ARI 210	Unitary Air-Conditioning Equipment
ARI 360	Commercial and Industrial Unitary Air-Conditioning Equipment

15-1.2.2 American Society for Testing and Materials (ASTM).-

A 36	Structural Steel
A 307	Carbon Steel Externally Threaded Standard Fastners
B 88	Seamless Copper Water Tube
B 221	Aluminum and Aluminum Alloy Extruded Bar, Rod, Wire Shapes and Tubes
F 880	Stainless Steel Screws

15-1.2.3 American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).-

Standard 52	Handbook, Equipment Volume Method of Testing Air-Cleaning Device Used in General Ventilation for Removing Particulate Matter
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15-1.2.4 National Fire Protection Association (NFPA).-

70	National Electrical Code (NEC)
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15-1.2.5 Associated Air Balance Council (AABC).-

National Standards for Field Measurement and Instrumentation, Total System Balance.

15-1.2.6 Underwriters Laboratories, Inc. (UL) -

Building Materials Directory

15-1.3 Materials.-

15-1.3.1 Motors.-

15-1.3.1.1 Size and type.- Motors shall be high efficiency type, and of sizes and capacities indicated.

15-1.3.1.2 Over/under voltage performance.- Motors shall be designed for operation at rated output with plus or minus 10 percent voltage variation at the input terminals.

15-1.3.1.3 Nameplate data.- Motor nameplate shall indicate name of manufacturer, model and serial numbers, amperes per phase, horsepower, voltage, maximum and minimum speeds, phases, and cycles, class, and indication of starting current at rated voltage.

15-1.3.1.4 Temperature rise.- Ambient cooled motors shall be thoroughly ventilated. When running continuously at full load and full speed, temperature rise above surrounding air shall not exceed 100 degrees F. Enclosed motors shall be rated on a 125 degrees F rise basis.

15-1.3.1.5 Shaft length.- Motors equipped with adjustable pitch motor sheaves shall be furnished with extended length driving shafts to match width of motor pulley and keyway length.

15-1.3.1.6 Acceptable Manufacturers.- Westinghouse, General Electric, Allis-Chalmers or approved equal.

15-1.3.1.7 Starters.- Motor starters for air handling fan, compressors, and condensing fans shall be fully enclosed automatic magnetic across-the-line type with three leg overload protection and under voltage release. The starter shall be equipped with contacts to break each ungrounded line conductor to the motor. Provide a reset switch for resetting overcurrent trip. Starters shall be Cutler-Hammer, Allen Bradley, Square D, or approved equal.

15-1.3.2 Motorized dampers. -

15-1.3.2.1 General.- Design dampers to close upon the failure of power. Furnish motors, switches, transformers, relays, timers, and other control devices. Dampers shall have two positions, low leakage type parallel blades designed to operate in the vertical position for horizontal air flow. Use American Warming and Ventilating, Model VC-20, or approved equal.

15-1.3.2.2 Blades.- ASTM B221, extruded aluminum alloy type 6063-T52, .074 inch thick. Furnish extruded silicone blade seals and polyurethane jamb seal.

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15-1.3.2.3 Frames.-- ASTM B221, extruded aluminum alloy type 6063-T52, .081 inch thick.

15-1.3.2.4 Shafts.-- Extruded aluminum, 1/2-inch diameter with oilite, bronze bearings and face mounted linkage.

15-1.3.2.5 Dissimilar materials.-- Separate the joints between aluminum and other metals with sheet lead, polyvinyl tape or sheet neoprene.

15-1.3.2.6 Fasteners.-- Stainless steel, Type 303.

15-1.3.3 Packaged unitary air-conditioner (ACU-2).-- Unit shall comply with ARI 210 and 360. The unit shall deliver not less than the cooling capacity and supply air quantity indicated. Capacity ratings to be in accordance with ARI standards. Unit shall be completely factory assembled, wired, charged and tested and as a minimum shall include an evaporator coil, condenser coil, evaporator fan, condenser fan, compressor, return filters, filter frame, refrigerant piping, drain pan, controls, insulated cabinet, and all associated and specified unit controls and wiring. Unit controls shall be arranged to permit remote operation and control from automatic temperature control system. Unit shall be UL listed and labeled. Cooling capacity to be certified by ARI.

15-1.3.3.1 Unit cabinet.-- All components of the packaged unit shall be enclosed inside a heavy gage weatherproof steel unit casing. Entire casing and drain pan shall be factory insulated with minimum 1-inch thick, 3-lb. density internal insulation to prevent condensation and minimize noise level. Drain pan to be treated with corrosion resistant coating. Insulation shall be a standard product of the unit manufacturer. Cabinet shall be equipped with removable panels properly sized and located to permit easy access to all components including filters. Unit shall be designed for horizontal discharge and return. Cabinet shall be factory finished with two coats of baked enamel paint.

15-1.3.3.2 Refrigerant coils.-- Evaporator and condenser coils shall be of non-ferrous construction with aluminum plate fins mechanically bonded to seamless copper tubes with joints brazed. Coils shall be leak tested at 150 psig, condenser coil to be pressure tested at 420 psig, and evaporator coil pressure tested at 300 psig. Condenser coil to be amply sized to provide required subcooling. Evaporator coil to be direct expansion type with refrigerant distributor and thermal expansion valve.

15-1.3.3.3 Fans and motors.-- Evaporator blower shall be double-width, double-inlet forward-curved, centrifugal, direct driven type statically and dynamically balanced, capable of operating at air quantity and external static pressure conditions indicated. Equip blower motor with permanently lubricated bearings. Condenser fan shall be propeller type with direct-driven permanently lubricated motor.

15-1.3.3.4 Wiring and controls.-- Controls shall be factory wired including fan and compressor contactors, high and low pressure cutouts, internal winding thermostat for compressor, control circuit transformer, non-cycling reset relay timer circuit to prevent restart of compressor more than once in five minutes, condenser fan interlocks and low ambient control. Unit shall also be equipped with a time delay relay to prevent short cycling and instantaneous compressor starts after interruption of power to compressor for any reason, whether due to safety devices, remote thermostat or commercial power failure. Low ambient control shall allow operation under ambient outdoor temperatures as low as minus 20 degrees F and shall consist of factory wired fan cycling head pressure control for condenser which cycles condenser fan in response to outdoor ambient temperature. The cooling system shall be protected with high/low pressure stats, loss-of-charge protection and current and temperature sensitive overload devices. Each motor shall be supplied with individual overload protection. All controls shall be factory wired and installed integral with unit. Single stage cooling is external to the unit and integral to the automatic temperature control systems.

15-1.3.3.5 Air filters.-- Air filters shall be extended area, pleated media, disposal type having medium efficiency and of the size and capacity indicated. Filter to provide nominal 30 percent efficiency when tested in accordance with ASHRAE 52. Filters to be Farr 30/30 or approved equal.

15-1.3.3.6 Condensate drain.-- Condensate drain line for air-conditioner unit shall be type L hard drawn copper conforming to ASTM B88, with wrought copper fittings. Provide P-trap in drain line. The end of the drain line shall be capped with 16-mesh copper screen.

15-1.3.3.7 Outside air intake.-- Equip unit with a motorized damper having locking stops to admit from 0 to 25 percent outside air into return air section upstream of air filter. Damper shall close when unit is off. Protect damper with a rainproof hood fabricated of the same quality and finish metal as the unit casing and a removable corrosion resistant metallic insect screen.

15-1.3.3.8 Supply grille.-- Two sets of individually adjustable double deflection extruded aluminum airfoil blades spaced at 3/4-inch centers with face blades parallel to the short dimension. Grille frames shall be aluminum with mitered corners. Titus Model 272FS or approved equal.

15-1.3.3.9 Return grille.-- Fixed-blade, aluminum grille, having curved or angular break, inclined blades parallel to the long dimension. Space the blades at 3/4-inch centers. Hemmed or fully rounded leading edges. Frames with mitered corners. Titus Core No. 3-FL or approved equal.

15-1.3.3.10 Security provisions.-- Equip removable panels with a cylinder type lock appropriate for the panel design and suitable for exterior application.

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15-1.3.3.11 Mounting brackets.-- ASTM A36, hot-dipped galvanized steel angles. Bolts ASTM A307, Grade B, hot-dipped galvanized and tamperproof. Secure unit to brackets with stainless steel screws, ASTM F880, Type 304.

15-1.3.3.12 Metal wall sleeves.-- Galvanized 26-gage metal. The annular opening around the sleeve shall be made watertight and covered with 1-1/2 inch by 1-1/2 inch by 1/8 inch galvanized steel angle weatherstrip with corners mitered, welded, and ground smooth.

15-1.3.3.13 Acceptable manufacturers.-- Unit shall be the product of a manufacturer regularly engaged in production of units of type and size specified and who issues complete catalog data. Marvair, Bard, Stiles or approved equal.

15-1.3.4 Unit Heater.--

15-1.3.4.1 General.-- UL listed and labeled. Heater shall be factory assembled, horizontal type, consisting of electric heating element, fan, motor, housing, outlet diffuser and controls. Use Electromode Company, Series EUH or approved equal.

15-1.3.4.2 Casing Minimum 18-gage, hot-dip galvanized steel, bonderized and factory finished with a baked-on enamel paint. Casing sides shall be readily removable for access and maintenance. Suspended units shall be designed for direct attachment to the hangers.

15-1.3.4.3 Vanes Adjustable type, horizontal and vertical vanes, nozzles or diffusers, arranged to provide uniform air distribution.

15-1.3.4.4 Heating element.-- Copper-clad steel sheath with aluminum fins.

15-1.3.4.5 Motor.-- Totally enclosed with built-in thermal overload protection and permanently lubricated ball bearings. Bearings shall be sealed, sleeve type.

15-1.3.4.6 Controls.-- Furnish controls and safety devices including automatic thermal limit switch, fan delay switch, and built-in unit mounted thermostat.

15-1.3.5 Automatic temperature controls.--

15-1.3.5.1 General.-- Control devices shall be 24 VAC type. Relays, switches, timers, transformers and other control devices shall be mounted in the unit control panel. Watt rating of control transformers shall be minimum 1-1/2 times total watt rating of connected control devices. Transformer shall be fused on the secondary side of control circuit. The air conditioning unit and controls shall be designed for year-around continuous and automatic operation. Use Honeywell or approved equal.

15-1.3.5.2 Tolerance.- An average variation of two degrees F, plus or minus from the set point of the thermostat setting is acceptable, subject to specified capacity limitations.

15-1.4 Installation.-

15-1.4.1 Motorized dampers.- Install in accordance with NEC, manufacturers instructions and the approved shop drawings.

15-1.4.2 Automatic temperature controls.-

15-1.4.2.1 General.- Install in accordance with the manufacturers instructions and the following:

15-1.4.2.1.1 Wiring and panel.- Control wiring shall be installed in conduit, parallel to building lines and surfaces. Mount the control panel on an insulated base and attach panel to wall. Top of panel shall be 6 feet above the floor.

15-1.4.2.1.2 Thermostats.- Mount thermostats 5 feet above the floor on an insulated base.

15-1.4.3 Unit heater.- Install in accordance with NEC, and the manufacturers instructions. Provide supports, hangers and isolators, and anchor bolts necessary to withstand the applicable seismic force.

15-1.4.4 Unitary air-conditioner.-

15-1.4.4.1 General.- Install in accordance with NEC, the manufacturers instructions and the approved shop drawings. Unit shall be supported and fastened to the wall as necessary to resist applicable wind and seismic loads.

15-1.4.4.2 Wiring and panel.- Control wiring shall be installed in conduit, parallel to building lines and surfaces. Mount the control panel on an insulated base and attach panel to wall. Top of panel shall be 6 feet above the floor.

15-1.4.4.3 Noise and vibration.- The entire system as installed shall be free of objectionable noise and vibration. Rotating components of air-conditioning unit shall be mounted on suitable vibration isolators and entire unit shall be acoustically treated with sound absorbing and vibration dampening materials to ensure unit sound levels do not exceed specified limits. The maximum allowable sound level of the air-conditioning unit at 5-foot distance, shall not exceed 55 dBA in the building interior and 75 dBA at the building exterior.

15-1.4.4.4 Air system adjustment.- Air system shall be adjusted and balanced so that return, supply and outside air quantities are as indicated and that distribution from air terminal is free from drafts, and uniform over the face of the terminal. Air quantities shall be measured by anemometer or velometer, depending on the velocity and other conditions of flow.

15-1/07

15-1.4.5 Existing air conditioning unit (ACU-1).-

15-1.4.5.1 Modifications.-

- (a) Add new low ambient controls designed to permit operation of system down to minus 20 F. Also modify 24V control system to permit supply fan to operate continuously and not cycle with the compressor.
- (b) Disable the economizer cycle if unit is so equipped.

15-1.4.6 Filters.- At the time of final acceptance install new filters in each air conditioning unit. Also furnish two spare filters for each air conditioning unit.

15-1.5 Quality assurance.-

15-1.5.1 Tests.-

15-1.5.1.1 Operating test - unitary air-conditioner.- Capacity of system shall be verified by operating tests of not less than four hours duration, after stable condition has been established. Test procedures shall be in accordance with AABC. Submit test reports.

15-1.5.1.2 Operating tests - control system.- Calibrate and test connected components to ensure the system performs in accordance with the sequence of operation shown on the drawings.

15-1.5.2 Submittals.- Conform to the procedures specified.

15-1.5.2.1 Product data.- Submit electric heating equipment, unitary air-conditioner, motorized damper and automatic temperature control catalog data. Manufacturer's catalog data shall completely describe each component and device incorporated into the equipment including control transformers, thermostat and relays. Catalog data shall be marked with red or other contrasting color by arrow, circling, underlining or equivalent to clearly identify each item and model.

15-1.5.2.2 Shop drawings.- Submit shop drawings for all equipment and a control wiring diagram showing complete interlock of wiring for input and output control devices, include:

- (a) Relay holding coils;
- (b) Contactors;
- (c) Thermostats;
- (d) Transformers; and
- (e) Switches to point of connection to factory installed wiring integral to air-conditioning system equipment.

15-1/08

Automatic temperature control equipment installation drawings including wiring diagrams.

15-1.5.2.3 Final balance and test report.- Submit final balance and test reports with the following data:

- (a) Tabulate final air volumes at supply and return air grilles;
- (b) Record temperatures indoors and outdoors;
- (c) Record entering and leaving dry bulb temperature of air handling unit;
- (d) Calculate fan capacity and supporting data;
- (e) Sound data for equipment room.

15-1.5.2.4 Schedule.- Submit a control device schedule which identifies and completely describes function and operation of each control device.

15-1.5.2.5 Test plan.- Submit a plan describing the system tests proposed for the existing air-conditioning and automatic temperature control systems.

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Attachment 1 of 2

UNITARY AIR-CONDITIONING SYSTEM

- I. AIR HANDLING SECTION _____
- (a) Manufacturer _____
- (b) Model Number _____
- (c) Serial Number _____
- (d) Outdoor air temp _____ degrees FDB; _____ FWB
- (e) Room air temp _____ degrees FDB; _____ FWB
- (f) Evap coil ent air Temp _____ degrees FDB; _____ FWB
- (g) Evap coil lvg air Temp _____ degrees FDB; _____ FWB
- (h) Evap fan motor:
- (1) Nameplate elec. service _____ volts, _____ phase, _____ cycles
- (2) Nameplate current _____ amps
- (3) Nameplate horsepower _____ hp
- (4) Measured current and voltage (at motor terminals):
- L1 _____ amps; _____ volts
- L2 _____ amps; _____ volts
- L3 _____ amps; _____ volts
- (5) Measured fan speed _____ rpm
- (6) Measured supply air quantity _____ cfm
- (7) Measured outside air quantity _____ cfm
- (a) On Outside air intake _____ cfm
- (b) Off outside air intake _____ cfm
- (i) Measured suction static pressure at fan _____ inches W.G.
- (j) Measured discharge static pressure at fan _____ inches W.G.
- (k) Design air quantities _____ cfm
- (l) Measured air quantities _____ cfm
(Items k and l, show for all supply and return air diffusers,
registers and grilles)

Attachment 2 of 2

II. AIR COOLED CONDENSING SECTION _____

(a) Refrigerant _____

(b) Compressor

(1) Suction pressure _____ psig

(2) Discharge pressure _____ psig

(3) High pressure cut-out _____ psig

(4) Low pressure cut-out _____ psig

(5) Nameplate elec. service ____ Volts, ____ phase, ____ cycles

(6) Nameplate current _____ amps

(7) Measured current and voltage (at motor terminals)

L1 _____ amps; _____ volts

L2 _____ amps; _____ volts

L3 _____ amps; _____ volts

(C) Condenser fan motor

(1) Nameplate elec. service ____ Volts, ____ phase, ____ cycles

(2) Nameplate current _____ amps

(3) Nameplate horsepower _____ hp

(4) Measured current and voltage (at motor terminals)

L1 _____ amps; _____ volts

L2 _____ amps; _____ volts

L3 _____ amps; _____ volts

16-1/01

16-1 ELECTRICAL WORK - GENERAL

16-1.1 General.-

16-1.1.1 Scope.- This section specifies furnishing and installing interior and exterior electrical equipment and materials.

16-1.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bids form a part of this specification and are applicable to the extent specified herein.

16-1.2.1 Federal Specifications (FS).-

J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
W-B-30	Ballast, Fluorescent Lamp
W-C-375	Circuit Breakers, Molded Case; Branch Circuit and Service
W-C-586	Conduit Outlet Boxes, Bodies, and Entrance Caps,
	Electrical: Cast Metal
W-J-800	Junction Box; Extension, Junction Box: Cover, Junction Box
	(Steel, Cadmium or Zinc - Coated)
W-P-115	Panel, Power Distribution
W-S-610	Splice, Conductor
QQ-W-343	Wire, Electrical (Uninsulated)
WW-C-566	Conduit, Metal, Flexible
W-F-414	Fixture, Lighting (Fluorescent, Alternating Current,
	Pendant Mounting)

16-1.2.2 Military Specifications.-

MIL-R-21931	Resin, Epoxy
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16-1.2.3 National Electrical Manufacturers Association (NEMA).-

OS1	Sheet Metal Outlet Boxes, Device Boxes, Covers, and Box
	Supports
MG 1	Motors and Generators
WD1	General Purpose Wiring Devices

16-1.2.4 National Fire Protection Association (NFPA).-

70	National Electrical Code (NEC)
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16-1.2.5 Underwriters Laboratories, Inc. (UL).-

UL 6	Rigid Metal Conduit
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UL 98	Enclosed Switches
UL 514	Outlet Boxes and Fittings
UL 542	Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 1242	Intermediate Metal Conduit

16-1.3 Materials.-

16-1.3.1 Heavywall steel conduit.- Heavywall zinc coated rigid steel conduit and fittings shall conform to UL 6 and UL 514. Rigid steel conduit may be used in all locations. Coated rigid steel conduit shall be used for installation below slab or grade, or underground. The conduit shall be factory coated with either .008 inch of epoxy resin in accordance with MIL-R-21931, .020 inch of polyvinyl chloride or .063 inch of coal tar enamel, or field wrapped with .01 inch thick pipe wrapping plastic tape applied with 50 percent overlap. Fittings for use with rigid steel conduit shall be threaded type and of the same material as the conduit. Where conduits enter boxes or cabinets without threaded hubs, double locknuts shall be used plus a phenolic insulated metallic bushing on the open end.

16-1.3.2 Intermediate steel conduit.- Intermediate zinc coated rigid steel conduit and fittings shall conform to UL 1242 and UL 514, and bear the UL label. Only factory made sweep ells shall be used. Field bends are not acceptable. Fittings shall be threaded type and of the same material as the conduit. Where conduits enter boxes or cabinets without threaded hubs, use double locknuts and phenolic insulated metallic bushing on each open end.

16-1.3.3 Flexible steel conduit.- Flexible steel conduit shall conform to FS WW-C-566. Use in 12 inch nominal lengths for terminal connections to motors or motor driven equipment, and use in short lengths for other applications as permitted by the NEC. Liquid tight flexible conduit shall be used outdoors or in wet locations. A separate ground conductor shall be provided across all flexible connections in addition to the green ground wire.

16-1.3.4 Conductors, uninsulated.- Copper in accordance with FS QQ-W-343.

16-1.3.5 Conductors, insulated.- Unless otherwise indicated, insulated conductors shall be copper with thermoplastic or thermosetting insulation, type THW, THWN, and XHHW for general use, or type THHN for use in dry locations only, all insulated for 600V in accordance with FS J-C-30. Conductors No. 10 AWG and smaller shall be solid, and conductors No. 8 AWG and larger shall be stranded. Use No. 12 AWG (min.) for branch circuit conductors. Use No. 14 (min.) for control wiring.

16-1/03

16-1.3.6 Wiring, fixture.- Copper, with thermoplastic insulation type TF, TFF, TFN or TFFN insulated for 600 volts, in accordance with FS J-C-30.

16-1.3.7 Boxes.- Boxes shall be either the cast metal hub type conforming to FS W-C-586 or shall be one piece galvanized steel type conforming to FS W-J-800. Where not sized on the drawings, boxes shall be sized in accordance with the NEC. Provide boxes in the wiring or raceway system for pulling wires, making connections, and mounting devices or fixtures. Boxes for metallic raceways shall be of the cast-metal threaded hub type rated for use in wet locations. Boxes in other locations shall be cast metal hub type or one piece galvanized steel with cover designed for surface installation. Each box shall have the volume required by the NEC for the number of conductors in the box. Each outlet box shall have a machine screw which fits into a tapped hole in the box for the ground connection. Boxes for mounting lighting fixtures shall be not less than 4-inches square. Boxes for use in masonry block walls shall be square-cornered tile-type, or standard boxes having square-cornered tile-type covers.

16-1.3.8 Wiring devices.-

16-1.3.8.1 Receptacles - general.- Receptacles shall be UL Labeled and of the voltage and current rating indicated. All receptacles shall be specification grade, side wired with two screws at each terminal. Unless noted otherwise, receptacles shall be installed 12 inches above finished floor. Receptacles shall be grounded by the installation of a green pigtail from the ground screw to the lug on the box where the green wire ground is connected. Receptacles shall have an ivory color finish.

16-1.3.8.1.1 Duplex.- NEMA WD1, Type 5-15R. Unless otherwise indicated, general purpose duplex receptacles shall be 15 amp, 125 volt, grounding type.

16-1.3.8.1.2 240 Volt.- NEMA WD1, type 6020R. Unless otherwise indicated, 240 volt receptacles shall be 20 amp, grounding type.

16-1.3.9 Switches, wall.- Wall switches shall be specification grade, rated 120/277 volts, and fully rated 20 amps, AC only. Wiring terminals shall be of the screw type. Switches shall be the quiet operating type, and ivory colored. Not more than one switch shall be installed in a single gang position. Unless indicated otherwise, switches shall be installed 48 inches above finished floor. Wall switches shall bear the UL label.

16-1.3.9.1 Switches, safety.- Safety switches shall conform to UL 98, heavy duty, unless otherwise indicated. Switches mounted in dry locations shall be in NEMA OS1, Type 1 enclosures. Switches installed outdoors, or in damp or wet locations shall be mounted in NEMA OS1, Type 3R enclosures. Switches shall be of the voltage and current ratings indicated, and each capable of interrupting the locked rotor current of the motor. The locked rotor current is assumed to be ten times the full rated load current. The switches shall be of the quick-make, quick-break type, parts shall be mounted on insulating bases to permit replacement of parts from the front of the switch. Current-carrying parts shall be of high-conductivity copper, designed to carry

rated load without excessive heating. Switch contacts shall be silver-tungsten type or plated to prevent corrosion, pitting and oxidation and to ensure suitable conductivity. Safety switches shall be lockable in either position.

16-1.3.10 Device plates.- Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel or cast metal having rounded or beveled edges. Plates on finished walls shall be of satin finish chromium plated brass. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. The use of sectional type device plates is not acceptable. Plates installed in wet locations shall be gasketed.

16-1.3.11 Photoelectric control.- Unless otherwise indicated, the photoelectric control for exterior entrance lights shall be 120 volt, 3000 watt, single pole, single throw, double break. Mount the photoelectric control in a waterproof watt hour meter socket.

16-1.3.12 Panelboards.- Panelboards shall conform to FS W-P-115 Type I, Class 1, be UL listed except for installations which require special panelboards to incorporate items not available as UL listed. All panelboards shall have a piano hinged door in the cover. Doors over 48 inches in height shall have auxiliary fasteners on top and bottom.

16-1.3.12.1 Gutters.- Side wiring gutters shall be 8 inches minimum for mains over 225 amps and up to 600 amps.

16-1.3.12.2 Circuit breakers.- UL listed, quick-make, quick-break, bolt on, thermomagnetic type, conforming to FS W-C-375. Rate circuit breakers for the voltage of the circuit on which they are used, minimum interrupting rating 22,000 amperes symmetrical for branch breakers, and 30,000 amperes symmetrical for main breakers. Circuit breakers shall have a trip indicating feature. Single pole breakers shall be a full size module, and two and three pole breakers shall be sized in even multiples of a single pole breaker. Size breakers so that two single pole breakers will not be capable of fitting in a single housing. Multipole circuit breakers shall have an internal common trip mechanism. Devices with an adjustable magnetic trip shall be factory set to the low value. Circuit breakers and the panelboards in which the breakers are installed shall be products of the same manufacturer. Self-enclosed circuit breakers shall be mounted in NEMA OS1, Type 1 enclosures with trip rating, voltage rating and number of poles as indicated.

16-1.3.12.3 Bus bars.- Buses shall be copper. Bus capacity shall be as indicated. Circuit breaker current-carrying connections to bus shall be bolted type and factory assembled. Stab-in types are not acceptable. Bus bar connections to branch circuit breakers shall be of the sequence phase type. Connect branch circuits to the individual circuit breakers as indicated. The neutral bus shall be insulated from panelboards. Panelboards shall have an uninsulated ground bus bolted to the cabinet, adequate in size to accommodate present and future equipment grounding conductors. Isolate ground bus from the neutral bus except at the service disconnect means. Where provisions for, future breakers are indicated, the panelboard shall be equipped with bus connections for future breaker installation.

16-1/05

16-1.3.13 Motors.— Shall conform to NEMA MG 1, minimum insulation Class B, squirrel-cage type, having normal starting-torque and low-starting-current characteristics. Motors shall be of sufficient size for the duty to be performed, and shall not exceed the full-load rating when the driven equipment is operating at specified capacity. Motors shall be rated for the voltage of the connected system. Unless otherwise indicated, motors shall have open frames, and continuous-duty classifications. The horsepower ratings indicated are for guidance only and do not limit the equipment size.

Provide each motor with a disconnecting means and a manually operable switch as indicated or when required by the NEC. For single-phase motors, a single or double-pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Enclose safety switches as specified. Switches shall disconnect all ungrounded conductors.

16-1.3.14 Fuses.— Fuses shall have a voltage rating not less than the circuit voltage. Cartridge fuses shall have an interrupting rating as indicated, but if not indicated shall be not less than 100,000 amps when used in branch and distribution circuits, and not less than 200,000 amps when used in a service entrance switch.

16-1.3.15 Lighting fixtures.—

16-1.3.15.1 General.— Lamps and lighting fixtures shall be of the types indicated, UL approved and bear the UL label. Incandescent lamps shall be rated for 120 volts.

16-1.3.15.2 Fluorescent fixtures.— Fixture lenses shall be the prismatic type, made of virgin acrylic. Lamps shall be rapid start, cool white. Ballasts shall be class P, rapid start, high power factor type conforming to FS W-B-30. Provide ballasts with choke type radio frequency interference suppressors. Ballasts shall bear the CBM/ETL label. Lampholders shall have silver plated contacts, and conform to UL 542. Pendant mounted fixtures shall conform to FS W-F-414 and of the types indicated. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent units shall have a tubing or stem for wiring at one point, and a tubing or stem suspension provided for each unit length of chassis including one at each end.

16-1.3.15.3 Incandescent fixtures.— Incandescent fixtures shall be provided for exterior lighting, type as indicated. Fixtures shall bear the UL label.

16-1.3.16 Surge arrestor (FAA furnished).— 120/208 V, 3-phase, 4-wire.

16-1.3.17 Splices.— Solderless connectors for splices shall conform to FS W-S-610.

16-1.4 Installation.—

16-1.4.1 Wiring.—

16-1.4.1.1 General.- In the three phase system specified, not more than one wire from each of the three phases shall be run with a common neutral. Neutral conductors shall extend from the neutral bus in the device where the active conductors originate. Device terminals for connection of more than one conductor shall be specifically designed for the purpose.

16-1.4.1.2 Raceways.- Minimum conduit size shall be 3/4-inch, 1/2 inch is acceptable for exposed control wiring conduit. Each run shall be complete, fished, and swabbed before conductors are installed. Cap ends of conduit systems not terminated in boxes or cabinets. Exposed raceways shall be installed parallel to or at right angles with the lines of the structure. A pull wire shall be installed in empty tubing and conduit systems. The pull wire shall be No. 14 AWG zinc coated steel, or plastic with a minimum 200 pound tensile strength. Ten inches of slack shall be left at each end of the pull wire. Sections of raceways which pass through damp, concealed or underground locations shall be of the type specified for such locations, and extending a minimum of 12 inches beyond the damp, concealed, or underground area.

Where conduit has to be cut in the field, cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and the same thread dimensions and taper as specified for factory cut threads on conduit.

Use rigid galvanized steel or intermediate metal conduit throughout the project except where flexible metal conduit is required for vibration, or where otherwise indicated. EMT is not acceptable.

16-1.4.1.2.1 Raceway support systems.- Raceways shall be securely supported and fastened in place at intervals of not more than 10 feet and within 3-feet of each outlet box, junction box, cabinet or fitting, with pipe straps, wall brackets, hangers, or ceiling trapeze. Fastenings shall be by wood screws, nails or screw-type nails to wood; by toggle bolts to hollow masonry units; by expansion-bolts to concrete; by machine screws, welded threaded studs, or spring tension clamps to steel work. Nail type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts or machine or wood screws.

Threaded C clamps with retainer may be used. Raceways or pipe straps shall not be welded to steel structures. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams shall not cut the main reinforcing bars. Holes not used shall be filled. In partitions of light steel construction, sheet metal screws may be used. Raceways shall not be supported from sheet metal roof decks.

16-1.4.2 Boxes.- Cast-metal boxes installed in wet location and boxes installed flush with the outside of exterior surfaces shall be gasketed. Separate boxes shall be provided for flush or recessed fixtures where required by the fixture terminal operating temperature, and fixtures shall be readily

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removable for access to the boxes. Boxes shall not be supported from sheet metal roof decks. Boxes and supports shall be fastened to wood with wood screws, nails, or screw-type nails of equal holding strength, with bolts and expansion shields to masonry and with machine screws or welded studs to steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used instead of expansion shields, or machine screws. In open overhead spaces, cast metal boxes threaded to raceways shall not be separately supported except where used for fixture support; cast metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 24 inches from the box. Penetration shall be no more than 1-1/2 inches into reinforced-concrete beams.

16-1.4.3 Splicing.-- Splices shall be made only at outlets, junction boxes, or accessible raceways. Use wire nuts to splice conductors sized No. 10 AWG and smaller, and compression connectors to splice conductors No. 8 AWG and larger. Splices shall be taped with electrical insulating tape in a manner which makes their insulation equal to the insulation on the conductors.

16-1.4.4 Device plates.-- Plates of the one piece type shall be provided for all outlets and fittings to suit the devices installed. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plates shall be installed with an alignment tolerance of 1/16 inch.

16-1.4.5 Photoelectric control.-- Install on the building exterior, faced in a northerly direction.

16-1.4.6 Service equipment.--

16-1.4.6.1 Power, general.-- Service entrance equipment shall be in accordance with the regulations of the local utility providing service and the NEC. The power service entering the building shall have a clockwise phase rotation throughout the building.

16-1.4.6.1.1 Conduits.-- Service entrance conduits shall be installed as indicated and shall be heavywall zinc coated rigid steel. Underground service entrance conduits shall be installed a minimum of 2 feet below finished grade.

16-1.4.6.2 Disconnect switch.-- Switches used for service entrance disconnecting shall be fused disconnecting type, UL approved and labeled for use as service equipment.

16-1.4.6.3 Surge arrestor.-- Surge arrestor shall be installed adjacent to (within one foot) and on the line side of the main service disconnect means as indicated. Arrestor shall be compatible with the voltage of the service, and wired in a manner to preclude sharp bends. Keep bends to a minimum. Connect the arrestor as recommended by the manufacturer. Phase lugs shall be

connected to corresponding phase terminals of the disconnect switch with insulated No. 4 AWG minimum stranded copper cable. The phase connection shall be on the line side of the disconnect. The connection to ground for the arrestor elements shall be routed as direct as possible to the closest ground rod or ground electrode. When the ground electrode conductor in the service disconnect is properly connected to the neutral conductor bus and is routed as specified, the ground for the arrestor elements shall be connected to the neutral bus in the service disconnect. The connection shall be as short as possible. Ground conductor for the arrestor elements shall be No. 4 AWG minimum stranded copper cable with appropriately color coded insulation when connected to the service disconnect switch. The enclosure for the surge arrestor shall be connected to the ground bus in the main service disconnect with No. 4 AWG copper wire having green insulation or color coded green.

16-1.4.7 Panelboards.- Panelboards shall be mounted so that the height to the top of the panelboard is 6 feet and 9 inches above the finished floor level. Directories shall be typed to indicate the load served by each circuit, mount in a holder with protective covering. Arrange the directory so that the typed entries simulate the circuit breaker positions in the panelboard.

16-1.4.8 Fuses.- A complete set of fuses shall be installed and one set of spares shall be furnished for each fusible device. Time/current tripping characteristics of fuses serving motors or connected in series with circuit breakers shall be coordinated for the proper operation.

16-1.4.9 Grounding.-

16-1.4.9.1 General.- Grounding system connections shall be made as indicated and in accordance with the NEC.

16-1.4.9.2 Equipment grounding.- All electrical equipment, including light fixtures and receptacles shall be grounded by means of a separate green insulated ground wire, minimum of No. 12 AWG, routed within the raceway. The ground conductor shall be connected to the power panel or lighting panel equipment ground bus. All metallic non-current carrying parts of electronic equipment shall be grounded to the grounding system.

16-1.4.9.3 Primary power ground.- Primary power shall be 3 phase, 4 wire, with one wire the neutral. At the service entrance safety switch, the neutral wire shall connect directly to the grounding grid. All AC power distributed from the power distribution panel shall be 4 wire with the neutral isolated from ground.

16-1.4.9.4 Protection.- Mechanical protection shall be provided for all cables in the ground system where they may be subject to damage. Protection shall be provided by conduit, floor trenches, routing behind permanent structural members, or other acceptable means. Where routed through metal conduit, bond conduit to the cable at each end.

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16-1.4.9.5 Raceway ground.-- Every component of metallic conduit runs such as individual sections, couplings, line fittings, pull boxes, junction boxes, and outlet boxes shall be bonded to the ground system. Conduit brackets and hangers shall be securely bonded to the conduit and to the metal structure to which they are attached. Wireways shall be bonded at each joint with a No. 6 AWG ground conductor.

16-1.4.9.6 Electronic ground conductor.-- Electronic ground system is indicated on drawings. Ground conductor shall be separate from equipment ground conductor, color shall be green with yellow tracer. Connections of electronic equipment to the electronic ground are NIC.

16-1.4.10 Identification.--

16-1.4.10.1 Nameplates.-- Each of the following types of equipment shall be identified with a name plate showing the functional name of the unit, voltage utilized, one or three phase as applicable, and other pertinent information. Switches for local lighting are not required to be identified.

Motor controllers
Panel boards
Switches
Self-enclosed circuit breakers

Other electrical equipment shall be identified if requested by the COR. Nameplates shall be non-ferrous metal or rigid plastic, stamped, embossed or engraved with 3/8 inch minimum height lettering or numerals. The plates shall be secured to the equipment with a minimum of two screws.

16-1.4.10.2 Color coding.-- Branch circuit and feeder conductors shall be color coded. The color coding shall be continuous throughout the facility on each phase conductor to its point of utilization so that the conductor phase connection is readily identifiable in any part of the installation. The equipment grounding conductor shall be as specified. Neutral conductors shall be continuous white. The neutral of the other systems shall be white with identifiable colored tracers (not green). Where color coding is not available in the larger size conductors, the conductors shall be color coded by use of color coded tape, half lapped for a minimum length of 3 inches. Where conductors are color coded in this manner, they shall be color coded in junction and pull boxes, accessible raceways, panelboards, outlets and switches, as well as at terminations. Conductors in accessible raceways shall be coded in such manner that by removing or opening the cover, the coding is visible.

Phase conductors shall be color coded as follows:

Three Phase

120/208 or 240 Volts

Phase A - Black
Phase B - Red
Phase C - Blue

16-1.4.10.3 Conductor markers.-- In addition to color coding, all line, phase, and neutral conductors shall be identified by plastic-coated, self-sticking, printed markers or permanently attached stamped metal foil markers. Panel and circuit numbers shall be identified.

Conductor identification shall be provided at terminations, and in junction boxes through which the conductors pass. Control circuit conductor identification shall be made by heat shrink tubing or permanently attached stamped metal foil markers. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved shop drawings. Hand lettering or marking is not acceptable.

16-1.4.11 Cutting and patching.-- Electrical work shall be carefully laid out in advance to avoid damaging work in-place or concealed work. Take the necessary precautions when cutting, channeling, chasing, or drilling the floors, walls, partitions, ceilings, or other surfaces. Damage to the building, utilities and equipment shall be repaired or replaced by skilled mechanics of the trades involved at no additional cost to the FAA.

16-1.5 Quality assurance.--

16-1.5.1 Submittals.-- Conform to the procedures specified.

16-1.5.1.1 List of materials and equipment.-- Submit complete list of materials and equipment. List shall include manufacturer's style or catalog numbers. Catalog cuts or other descriptive data shall be furnished if required by the COR. Partial lists submitted from time to time are not acceptable.

16-1.5.1.2 Shop drawings.-- Shop drawings shall be submitted for materials and equipment not completely identifiable by information submitted in the materials and equipment lists.

16-1.5.2 Tests.-- Perform the following test and submit test results.

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16-1.5.2.1 Load balancing.-- After the electrical work has been completed, take current readings with a clamp-on ammeter on each phase of the feeders to each panelboard, and on the main service conductors. Redistribute the loads where greater than a 20 percent difference between readings in any two phases. If any phase is loaded above 80 percent of the rating of its over-current protective device, and corrective action cannot be taken, notify the COR.

16-1.5.2.2 Insulation resistance.-- Feeders and branch circuits shall have their insulation tested after installation, but before connection to fixtures or equipment. Motors shall be tested for grounds or short circuits after installation but before start-up. Conductors shall be free from short circuits and grounds, and a minimum insulation resistance phase-to-phase and phase-to-ground shall be 10 megohms measured with a 500 volt insulation resistance tester.

16-1.5.2.3 Neutral isolation.-- After installation of branch circuits, the neutral in the service entrance switch shall be tested for isolation from ground with an ohmmeter set on its RX1 scale. The incoming neutral shall be temporarily disconnected to accomplish this test. Contact between the neutral and ground, other than at the service entrance switch, is a possible cause of noise in electronic equipment and shall be corrected.

16-1.5.2.4 Operating.-- After the interior wiring system installation is completed, and at such time as the COR directs, conduct an operating test. The test shall demonstrate that the equipment is operating in accordance with the specified requirements.

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16-2 ENGINE/GENERATOR INSTALLATION

16-2.1 General.-

16-2.1.1 Scope.- Remove existing engine/generator and accessories. Install the new FAA furnished generator and accessories specified. Existing engine generator will remain the property of the FAA.

16-2.1.2 Qualifications of contractor.- Work under this section of the specifications shall be performed by a contractor experienced in installing generators.

16-2.1.3 Related work in other Sections.-

Section 15-1: Motor operated dampers

Section 16-1: Electrical work - general

Section 16-3: Procedure for removal of existing equipment

16-2.1.4 Delivery, storage and handling.- FAA furnished products shall be inspected for defects and deficiencies. Notify the COR of all significant defects or deficiencies discovered during the inspection. Also notify the COR of damage caused during shipping or unloading the generator at the site.

16-2.1.4.1 Preserving and storing existing engine/generator.- After decommissioning preserve, pack and crate the existing engine/generator as specified. Store on-site in a weatherproof enclosure. The FAA will arrange transportation from the site.

16-2.1.5 Disposal.- The following materials are deemed not suitable for reuse and shall be removed from the site and legally disposed of:

- (a) Exhaust muffler and piping.
- (b) Conduit and wiring.
- (c) Deteriorated fuel piping
- (d) Grounding cable.

16-2.1.6 Preoperation instructions.- A water-reisistant envelope should be attached to the front of the control panel containing preoperation instructions, in addition to the standard Operating and Maintenance Manual. The instructions should give the necessary data for preparing the engine/generator set for operation. Included should be instructions for removing ties from the relays, clearing openings of adhesive tape, cleaning relay contacts, filling radiator, crank-case, and adjusting fan belt. The envelope should be marked in large bold print PREOPERATING INSTRUCTIONS.

16-2.2 Applicable documents.- The current issues of the following documents in effect on the date of invitation for bids form a part of this specification and are applicable to the extent specified herein.

16-2.2.1 Federal Specifications (FS).-

TT-E-489	Enamel, Alkyd Gloss (for Exterior and Interior Surfaces).
TT-P-636	Primer Coating, Alkyd, Wood and Ferrous Metal.
WW-P-406	Pipe, Steel (seamless and welded) (for ordinary use).
WW-P-521	Pipe Fittings, Flange Fittings, and Flanges, Ferrous and Steel, (Screwed and Butt-welded) 150 pounds.

16-2.2.2 National Fire Protection Association (NFPA).-

30	Flammable and Combustible Liquids Code.
31	Installation of Oil Burning Equipment.
70	National Electrical Code (NEC)

16-2.2.3 International Conference of Building Officials.-

Uniform Building code (UBC)

16-2.3 Materials.-

16-2.3.1 FAA furnished equipment.-

- (a) Diesel engine/generator
- (b) Engine/generator instrument panel and power control panel with Remote Maintenance Subsystem (RMS) interface.
- (c) Systems:
 - 1. Voltage regulation
 - 2. Air intake
 - 3. Cooling
 - 4. Exhaust
 - 5. Fuel
 - 6. Ignition
 - 7. Lubricating
 - 8. Mounting
 - 9. Starting.
- (d) RMS microprocessor and Remote Maintenance and Monitoring System (RMMS) interface.

16-2.3.2 Piping.- Black steel pipe conforming to FS WW-P-406, Weight A, Class 1, threaded to accommodate WW-P-521 flanged couplings.

16-2.4 Installation.-

16-2.4.1 General.- Install engine/generator in accordance with NFPA 30, 31 and 70 and the approved shop drawings.

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16-2.4.2 Vibration isolation.- The engine/generator skid mounting will be provided with vibration isolation mounts designed for 95 percent dampening effect. Isolation mounts may be installed either above or below the bedplate. The total engine/generator, including the exhaust piping and accessory systems, shall be installed to operate satisfactorily in the applicable Seismic Zone.

16-2.4.2.1 Seismic protection.- Provide isolators designed to withstand the applicable seismic force in accordance with the UBC. Provide suitable snubbers where required to prevent excessive sway, lateral movement or damage to equipment.

16-2.4.3 Exhaust system.-

16-2.4.3.1 General.- Factory fabricated engine exhaust system will include: exhaust manifold, piping, mufflers, pipe hangers, flexible brackets, expansion joints and insulation. Exhaust components will be insulated with R9, solid, preformed, removable insulated jacket designed to maintain 150 degrees F maximum surface temperature.

16-2.4.3.2 System mounting.- Except for the atmospheric terminal, the system shall be mounted indoors. Support the system using flexible brackets and hangers, allow for a thermal expansion of at least 1-inch for each 10 feet of exhaust pipe, and install to allow the engine to vibrate without disturbing the system.

16-2.4.3.3 Atmospheric terminal.- Extend the exhaust pipe through the building wall to a distance beyond the wall as indicated on the drawings. Support the end of pipe extension as detailed. Install a 18-gage, galvanized metal flashing collar around the exhaust pipe at the wall penetration. Fasten collar to the masonry wall with stainless steel lag bolts and lead expansion sleeves. Do not fasten pipe to collar or otherwise restrict the movement of the pipe during engine/generator operation.

16-2.4.4 Wiring.- Install control cabinets in accordance with the approved shop drawings and the engine/generator manufacturer's instructions. Run conduits and wiring between the entrance switch or breaker, bypass switch, generator control cabinet, and starting batteries. Also size and install the RMS interface cable from the engine/generator to the RMS panel. Identify all switches and cabinets by stenciling on the front of each item of equipment, with a 1-inch stencil, or smaller if necessary, the voltage, phase, and function of the item of equipment.

16-2.4.5 Connecting diesel fuel piping.- Install new piping, elbows and other fittings necessary to connect the new engine/generator to the existing diesel fuel piping system.

16-2.4.6 Touch-up.- Touch-up all rust spots and scratches on the engine generator and associated equipment. Rusted areas shall be sanded down and primed with paint conforming to FS TT-P-636. Use alkyd gloss enamel conforming to FS TT-E-489. Match the existing paint color on the engine generator and associated equipment.

16-2.5 Quality assurance.-

16-2.5.1 Submittals.- Conform to the procedures specified.

16-2.5.1.1 Reference drawings.- The FAA will provide the generator manufacturers drawings and data including the following:

- (a) Complete assembly layout and installation drawings;
- (b) Mounting provisions including isolators;
- (c) Piping, tubing layout and flow diagrams;
- (d) Interconnection diagrams;
- (e) One line, block and schematic diagrams for electric power;
- (f) Logic, schematic and wiring diagrams for control and instrumentation;
- (g) Descriptions of operation, installation, and maintenance requirements;
- (h) Instrument list including measured variable range and calibration data;
- (i) Data pertinent to performance, efficiency, device coordination, air flow requirements for cooling and combustion;
- (j) Minimum spacing required for equipment servicing and replacement of parts; and
- (k) Limits of fire and explosion hazard areas which require special electrical installation.

16-2.5.1.2 Shop Drawings.- Submit shop drawings, include the following:

- (a) Plan of engine/generator room showing the location of all equipment and accessories;
- (b) Engine/Generator mounting details including isolators and seismic protection;
- (c) Exhaust pipe wall penetration detail;
- (d) Piping schematics including seismic isolators; and
- (e) Electrical schematics and wiring diagrams.

16-2.5.1.3 Test plan.- Submit a detailed list of all proposed field tests and field operations. Include piping tests, equipment tests, electrical phasing tests, and insulation resistance tests.

16-2.5.1.4 Test report. Submit certified copies of field test data, indexed by particular field test performed. FAA will furnish Project Level Test matrix (Table 6.2-1 from the Engine/Generator Procurement Specification).

16-2.5.2 Tests.-

16-2.5.2.1 Operational test.- Perform a complete engine/generator system operational test. Perform all on-site testing in the presence of the Engine/generator manufacturers factory trained technical representative. Testing shall include:

- (a) Check of all systems for proper installation;
- (b) Flows;

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- (c) Restrictions;
- (d) Leaks;
- (e) Vibration;
- (f) Phase rotation;
- (g) Voltage;
- (h) Frequency;
- (i) RMS Interface;
- (j) Safety shutdowns; and
- (k) Operating with all types of load transfer.

Associated auxiliary items shall also be inspected for their connection/interaction with the engine generator. Provide a 4-hour full load test with load bank including load bank operation at 110 percent load and all types of load transfer. Demonstrate that the installed set successfully meets steady state regulation, transient response, voltage regulator and generator rating on either a load bank or the existing site load.

16-2.5.2.2 Testing of RMS.— Test the following inputs/outputs between the engine/generator and the RMS interface (the FAA will furnish supervision during testing):

16-2.5.2.2.1 Inputs.—

(a) Analog

- (1) Accumulated engine hours;
- (2) Lubricating oil level;
- (3) Lubricating oil pressure;
- (4) Lubricating oil temperature;
- (5) Cooling water temperature in;
- (6) Cooling water temperature out;
- (7) Fuel pressure (after regulator);
- (8) Intake manifold temperature (for turbocharged engines);
- (9) Exhaust manifold temperature;
- (10) Each cylinder temperature;
- (11) Waste heat water temperature in (when equipment option is exercised);
- (12) Waste heat water temperature out (when equipment option is exercised);
- (13) Battery voltage;
- (14) Battery charging current;
- (15) Generator voltage (each phase);
- (16) Generator current (each phase);
- (17) Generator power (kW);
- (18) Counter, number of power failures;
- (19) Counter, number of successful engine starts;
- (20) Counter, number of successful power transfers;
- (21) Generator frequency;
- (22) Commercial source voltage (each phase); and
- (23) Commercial source current (each phase).

(b) Contact closure

- (1) Safety switch off;
- (2) Engine cranking;
- (3) Overcrank;
- (4) Engine running;
- (5) Overspeed;
- (6) Engine stopped in emergency mode;
- (7) Engine on back-up fuel (dual fuel engines):
- (8) Fuel filter excessive pressure drop;
- (9) Air filter excessive pressure drop;
- (10) Cooling water level low;
- (11) Generator main circuit breaker on;
- (12) Generator main circuit breaker tripped;
- (13) Automatic transfer equipment in emergency position;
- (14) Controls set on local;
- (15) Operational control/monitoring failure (shall include controller fault, control power failure, high temperature in electronic enclosure);
- (16) Load bank tripped;
- (17) Load bank main contactor on;
- (18) Load bank over-temperature;
- (19) Load bank step contactor on (each step);
- (20) Battery charger charging; and
- (21) Battery charger alarm.

16-2.5.2.2.2 Outputs.-- The standby power unit shall completely operate as a result of commands from RMS including;

- (a) Start/stop engine in no load/load bank test mode;
- (b) Start/stop engine in extended load test (load transfer) mode;
- (c) Load bank main contactor on/off; and
- (d) Load bank step contactors on/off for each step.

16-2.5.3 Preservation.--

16-2.5.3.1 Cooling system.--

- (a) The cooling system shall be filled with a 50-percent solution of a permanent antifreeze.
- (b) With the fuel flow to the engine interrupted to prevent starting, the engine shall be continuously cranked by the starter and suitable preservative oil sprayed into the engine air intake until fumes from the preservative oil show at the exhaust opening or for a period of 20-seconds whichever occurs first.
- (c) Preservative oil shall be sprayed into the exhaust manifold including the turbocharger if furnished, for a minimum of 15 seconds.

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- (d) All exposed unpainted ferrous metal surfaces except fan belt pulley or other similar surfaces shall be covered with a thin coat of preservative lubricant.
- (e) The entire cooling system including the immersion heater shall be completely drained.
- (f) The immersion heater valves shall be set in the open position and the electrical plugs disconnected from the receptacle and secured in such a manner to prevent damage during shipment.
- (g) All openings in the engine shall be sealed with a suitable tape material to prevent entrance of moisture and insects.

16-2.5.3.2 Packing.- All contactors and relays other than totally enclosed devices shall be blocked and secured with twine or rubber band to prevent movement during shipment. Small delicate open type devices may be omitted. All switches, circuit breakers and rheostats shall be set in the off or minimum position. Control cabinets that are mounted on a frame over the generator shall be sufficiently blocked to prevent movement. A minimum of two metal bands shall be placed around the cabinet and firmly secured to the rigid supporting frame. A protective material shall be placed between the metal straps and the control cabinet and all openings sealed with a suitable tape. Fan belts shall be loosened prior to packing and shipment. Sufficient dessicant material or temporary space heaters shall be provided to keep the air dry inside the package.

16-2.5.3.3 Crating.- Crate as required for safe delivery. The minimum acceptable package shall be a 8-mil thick plastic shroud covering the engine generator and control cabinet, enclosed in slatted wooden crate and mounted on 4-inch by 4-inch wooden skids.

16-2.5.3.4 Marking.- Marking shall comply with the instructions furnished by the COR.

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16-3 POWER SYSTEM SWITCHOVER

16-3.1 General.-

16-3.1.1 Scope.- Provide proper work sequencing in order to minimize power system interruption and the resultant effect on the operational radar. The power system transition sequence specified below in conjunction with the one line diagram shown on the drawing is provided as general guidance for the power system switchover. Submit a planned work sequence which includes specific system interruptions.

16-3.1.2 Notification.- Notify the COR four working days prior to interrupting the power systems to ensure scheduling during periods of low aircraft operational activity.

16-3.1.3 Sequence.-

16-3.1.3.1 Temporary power service to facility, Panel A, refer to the one line diagram.-

- (a) Furnish and install a temporary standby diesel generator. Facility continues to be served by the existing service transformer with backup from existing engine/generator. Temporary standby engine/generator shall be 75 kW minimum and auto start and load transfer on loss of primary power source.
- (b) Install temporary jumper cable from service entrance switch to existing Panel A.
- (c) The facility is now served from the existing service transformer through the temporary jumper and existing Panel A with backup power from portable engine generator.

16-3.1.3.2 Removal of existing equipment as shown on the one line diagram.-

- (a) Remove existing engine generator and auxiliaries.
- (b) Remove automatic transfer switch and associated wiring from existing 400 amp bypass switch.
- (c) Remove engine cranking battery.

16-3.1.3.3 Installation of new electrical equipment.-

- (a) New service entrance equipment;
- (b) New engine/generator;
- (c) New load bank and controller;

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- (d) New Panel EPA; and
- e) Branch circuit to new and reconnected equipment. Except service to Panel A.

16-3.1.3.4 Energizing of new service and testing of new equipment.- Serve all new loads from new power service through panel EPA with new engine/generator as a backup. Panel A and branch circuits are served from existing power service through jumper cable.

16-3.1.3.5 Switching of facility over to new power service.-

- (a) Deenergize old service to Panel A by opening existing 400 ampere service entrance switch;

- (b) Remove temporary jumper; and

- (c) Connect Panel A service to Panel EPA.

Total facility is now served from the new power service equipment. Remove 400 amp service entrance switch and portable diesel generator. Determine the owner of the existing transformer to be removed and give timely notice for removal.

16-3.2 Applicable documents.- Not used.

16-3.3 Materials.- Not used.

16-3.4 Installation.- Not used.

16-3.5 Quality assurance.-

16-3.5.1 Submittals.- Conform to the procedures specified.

16-3.5.1.1 Transition plan.- Submit a transition plan formulated to minimize power interruptions to the radar and HVAC equipment, include a step-by-step detailed procedure with estimated time intervals between steps.

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